The Effects of Riparian Vegetation upon the hydraulics of flood flows

Tom Griggs

Public Comments

No public comments were received for this proposal.

Technical Synthesis Panel Review

Proposal Title

#0218: The Effects of Riparian Vegetation upon the hydraulics of flood flows

Final Panel Rating
inadequate

Technical Synthesis Panel (Primary) Review

TSP Primary Reviewer's Evaluation Summary And Rating:

The objectives of this proposal are relevant and clearly stated: restore floodplains without losing hydraulic controls of river. However, the approach is not well designed. The project actually has two parts, one applying to the goals and title, that is, the relationship between riparian vegetation and river hydraulics, and the other dealing with evaluation of bank erosion and river migration. The former is not well developed and assumes the TAC will address this veg/hydraulics connection, while the latter is well developed but not that relevant to the objectives of the proposal. Of concern is that the TAC, which will make recommendations of veg/hydraulic relationships has no world class expert in either riparian vegetation nor vegetation/hydraulics modeling.

Additional Comments:

The objectives of this proposal are relevant and clearly stated: restore floodplains without losing hydraulic controls of river. However, the approach is not well designed. The project actually has two parts, one applying to the goals and title, that is, the relationship between riparian vegetation and river hydraulics, and the other dealing with evaluation of bank erosion and river migration. The former is not well

developed and assumes the TAC will address this veg/hydraulics connection, while the latter is well developed but not that relevant to the objectives of the proposal. Of concern is that the TAC, which will make recommendations of veg/hydraulic relationships has no world class expert in either riparian vegetation nor vegetation/hydraulics modeling.

Technical Synthesis Panel (Discussion) Review

TSP Observations, Findings And Recommendations:

Although this proposal clearly states goals that are important and relevant, the proposed study addresses only one of the stated issues (bank erosion). Moreover, the bank erosion model and its incorporation of riparian vegetation effects are weak and empirical, with high potential for error and little physical insight. Furthermore, that portion of the budget is poorly explained The second goal (effects of riparian vegetation on hydraulics and flooding) is barely discussed and apparently reduced to a vague expert panel, results of which, are highly uncertain. Investigators seem unaware of the abundant, rigorous, physically based studies in the literature concerning the effects of riparian vegetation and wood debris on channel hydraulics, morphology, aquatic habitat, and flood conveyance.

Technical Review #1

proposal title: The Effects of Riparian Vegetation upon the hydraulics of flood flows

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**The overall goals and objectives are clear. The overall goals are to measure the influence of riparian vegetation on flood hydraulics and to develop guidelines for management of riparian vegetation that meet both objectives for flood control and wildlife habitat. The project proposes to (1) determine the effects of vegetation composition/structure on bank erosion rates from 1978 to present at 38 "adaptive management" sites established to look at this question, (2) convene a Technical Advisory Committee to develop Best Management Practices for vegetation management/restoration in the floodway of the Sacramento and other California Rivers. Both of these objectives are based on the overarching hypothesis that restoration and management of riparian habitats can be compatible with flood control and bank erosion objectives on northern California rivers. I believe these that are timely and important ideas for the science and practice of river management. The effect of riparian vegetation composition on bank erosion and channel migration rates has been often discussed, but seldom quantified. This theme has practical importance for managing floodplains for the joint benefits of wildlife habitat and protection of banks and flood control infrastructure. Determining guidelines for restoration design and vegetation management that will meet both habitat and flow conveyance needs is also an important and potentially useful exercise.**
Rating	

	very good

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**The overall conceptual model that motivates this project is the idea that the goals of conserving/restoring riparian habitat and reducing flood risk and bank erosion can be compatible, rather than conflicting, objectives.** **The section dealing with the channel migration modeling is well−documented and builds upon previous study. Work by Micheli et al. (2004), using an earlier version of the channel migration model, showed that river bends with riparian vegetation had much lower rates of erosion than bends bordering agricultural lands. The work proposed here will build upon the work by Micheli et al. but will apply more advanced techniques (include variable flows, bank elevations, etc.) and will attempt to isolate the effects of riparian vegetation composition and structure on bank erodibility. A conceptual model is presented that adequately describes the rationale for the modeling approach is presented, but there is little review of the mechanisms by which vegetation affects (positively or negatively) bank stability.** **The second major part of this project, the development of restoration guidelines and Best Management Practices, is based on the goal of providing valuable riparian**

	wildlife habitat in a way that is compatible with management of the floodway for flood conveyance. Floodways may provide ideal areas for plant growth and development of wildlife habitat, yet vegetation development in the floodway has often been considered counter to flood conveyance goals. The conceptual model for this is based on the idea that different species of plants and different structural arrangements of vegetation will have different effects on (or be differentially affected by) flood hydraulics and geomorphic processes. Hence, there may be some species of plants and structural arrangements of vegetation that are beneficial to both wildlife and flood management goals. One theme that is mentioned only briefly is the potential effect of increased hydraulic roughness (from vegetation) on flood stage, which ought to be an important consideration in habitat/floodway design. Given the overall title of the proposal ("The effects of riparian vegetation upon the hydraulics of flood flows"), I would have expected this theme to receive more consideration. **The selection of a research project is justified.**
Rating	**good**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	

The approach is well designed and appropriate overall for meeting the objectives of the project. As I indicate above, however, the authors should consider more explicitly the potential effects of vegetation roughness on flood stage.

Part I (task 2) of the proposal, dealing with channel migration modeling and vegetation, is based upon modeling approaches that have been used successfully on other projects on the Sacramento and elsewhere. The modeling methods are well-described in this proposal. The part of this work that was slightly unclear is how vegetation would be sampled and how the more detailed vegetation data (stem densities, dbh, etc.) would be used in the modeling process. Although present-day vegetation can be characterized in this way, it may be challenging to back-calculate vegetation structure of 27 years ago, unless one can assume similar vegetation structure on similarly aged plots (e.g., 10-year old cottonwood patches). Overall, however, the approach of the channel migration modeling appears feasible and should yield more refined estimates of the effect of riparian vegetation composition and structure on channel migration rates. To achieve this will require sampling across a wide enough range of vegetation conditions to separate out the effect of vegetation composition and structure on bank erosion. It is not clear to what extent this range of conditions is available at the 38 sites, although sufficient variability should be provided by nearby agricultural and other land cover types along the Sacramento River. Determining the effects of vegetation structure on bank erosion would be a definite aid in projecting the influence of land cover change from vegetation management or restoration on future migration rates.

Part II, tasks 3-5, seems feasible, although few details are given on how the Technical Advisory Committee will develop their restoration guidelines or Best Management Practices. It is not clear, for instance, to what degree case studies or hydraulic

	modeling will be used to determine vegetation–hydraulic relationships. The overall approach appears to be based more on expert opinion. I believe that this will be a useful exercise in at least exploring the possible tradeoffs in habitat structure/composition and maintenance of appropriate hydraulic characteristics of the floodway. The relationship between vegetation and hydraulics is complicated and incompletely understood. Hence, as the authors seem to suggest, this exercise may function more to develop hypotheses than to provide definitive standards for floodway management. However, this is still a useful start that asks questions that should be very important to decision–makers, particularly given the joint goals of habitat restoration and flood conveyance.
Rating	**good**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**As I indicated above, the approach for the channel migration modeling is well–documented and technically feasible, although the vegetation component (sampling, characterization) still needs refinement. I believe, however, that this part of the project has a high likelihood of success and is well within the capability of the authors.** **The second part of the proposal, dealing with the development of restoration guidelines and BMPs for floodway vegetation management, is quite ambitious and only sparsely documented. The effects of vegetation on flood hydraulics (and vice versa) is a complicated issue that deserves further study. Given that the project appears to rely on expert opinion, rather than direct study, it is likely to only develop rough guidelines and hypotheses for the effects of different**

	vegetation composition/structure on flood conveyance. Even rough ideas like these, however, is a step in the right direction. Initial efforts like these should be followed up by more detailed study or modeling of alternative vegetation configurations in the floodway. **Overall, the scale of the project appears appropriate and consistent with the objectives and the capabilities of the authors. As indicated above, the effects of vegetation on flood stage should be more explicitly examined as a part of the overall hypothesis/objective of ecologically and hydraulically sound restoration designs. Aside from the rather sparse documentation on Part II (development of BMPs, etc.), I am a little concerned that the authors have not looked more broadly for scientists to include in the Technical Advisory Committee (TAC) [to be fair, however, they do indicate that they will add other committee members as needed]. While the participants listed all appear to be highly qualified, I would recommend supplementing the TAC with a few internationally prominent specialists in these issues (i.e., riparian vegetation structure and flood hydraulics). Possible candidates could include ecologists who specialize in riparian vegetation and fluvial processes (e.g., USGS scientists from Fort Collins, such as Jonathan Friedman or Michael Scott) and/or hydrologists and geomorphologists with extensive experience in modeling these processes (e.g., J. Dungan Smith of USGS, Wil Graf of U. South Carolina, or Bill Dietrich at UC–Berkeley). Investing in 2–3 internationally recognized authorities in these areas would increase the stature of this work and could contribute to developing more rigorous management guidelines that could be applicable not only on the Sacramento, but more widely as well. Given that one of the goals is also to produce valuable wildlife habitats, it also may be worthwhile to include a local wildlife biologist on the TAC as well.**
Rating	**good**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	**Some vegetation sampling is proposed, but no monitoring per se. Monitoring to evaluate the projections of the channel migration model could be useful. Some further monitoring/field work and modeling could also be useful for evaluating the restoration/floodway management guidelines being developed in the second part of the proposal.**
Rating	**not applicable**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**Yes, I think that valuable products are likely from this project. The first part of this project will quantify the effects of riparian land cover on channel migration rates, maps of vegetation composition and age, and will forecast possible future rates of channel migration. These could all be useful in restoration and management of the Sacramento River floodplain.** **I believe that this project will also develop useful guidelines for riparian restoration that are compatible with floodway management (and vice versa). However, these guidelines are likely to be approximate and might better be considered as hypotheses or scenarios that are worthy of further study, perhaps through an adaptive management approach. Nevertheless, such ideas should be useful and should be widely disseminated. Given the importance of this issue, perhaps something more formal than simply**

	presentations to different groups and scientific articles should be considered (say a white paper for CALFED, a web site promoting the guidelines, etc.).
Rating	**good**

Additional Comments

Comments

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**The authors have a strong track record. The group doing the channel migration modeling has successfully applied their model to other projects on the Sacramento and elsewhere in the past. This project is a logical next step for applying their latest model enhancements and for investigating more deeply the influence of vegetation on channel migration. River Partners has a strong record of riparian restoration and project management on multiple CALFED projects over the years. The prospective members of the Technical Advisory Committee also appear to be highly qualified. However, given the complexity of the topic, I would also highly recommend that the authors consider expanding the committee to include some world-class authorities on the interactions between riparian vegetation and channel hydraulics. A mixture of qualified scientists and practitioners who really know the local systems well, with a few outside specialists who can provide a technically rigorous and broader perspecitve, would make for a very strong Technical Advisory Committee.**
Rating	**good**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**The budget appears to be reasonable and adequate for the work proposed. The two biggest expense areas are the subcontract to UC–Davis for the channel migration modeling work ($294,000 + overhead) and the cost of the Technical Advisory meetings ($235,000). While the budget for the channel modeling does not seem out of line, I would have liked the authors to give a breakdown of how it will be spent (I assume primarily on personnel), rather than only providing a lumped sum for the subcontract.**
Rating	**good**

Overall

Provide a brief explanation of your summary rating.

Comments	**The objectives of this project are ambitious and highly relevant to important issues in restoration and floodplain management on the Sacramento and other northern California rivers. A better understanding of the relationship between riparian land cover and channel migration would have both scientific and practical value for floodway management. The goals of the Technical Advisory Committee for examining vegetation–hydraulic interactions and developing restoration/management guidelines would also be highly valuable for designing floodway management that meets both ecological restoration and flood control objectives. However, documentation in parts of the proposal, particularly on development of restoration guidelines and Best Management Practices, was a bit sketchy. Finally, although the prospective members of the Technical Advisory Committee are highly qualified,**

	I would also have greater confidence in the quality, rigor, and applicability of the work of the TAC if it included one or more world-class experts on riparian vegetation ecology and vegetation-hydraulic modeling.
Rating	**good**

Technical Review #2

proposal title: The Effects of Riparian Vegetation upon the hydraulics of flood flows

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**The goals, objectives and hypotheses are clearly stated, but they are not internally consistent. The hypothesis incorporates issues related to both flood control and bank erosion. Flood control relates to both the stability of the flood control (i.e., levee) system and it's flood carrying capacity. The stated goal of the project is to "...develop quantitative measures of the effects of riparian vegetation upon the hydraulics of river flood flows...", which is primarily an issue of flood carrying capacity. Except to the extent that the Technical Advisory Committee (TAC) will be asked to answer several questions related to the effects of different types of vegetation on hydraulic roughness and sediment trapping, the objectives are related only to bank erosion and lateral migration issues.** **The idea behind the hypothesis is timely and important because of the increasing emphasis on maintaining a healthy riparian corridor while still protecting public safety.**
Rating	**fair**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**A study to test the hypothesis that "Ecosystem Restoration Program riparian vegetation habitat objectives can be designed and managed consistent with flood control and bank erosion objectives" is justified relative to existing knowledge. However, the proposed study is almost entirely focused on the effects of vegetation on bank erosion and lateral migration tendencies of the river. While this is an important issue with respect to the stability of the flood control system, vegetation also has significant effects on the actual flood carrying capacity of the system due to its effect on hydraulic roughness.** **The conceptual model for the portion of this hypothesis that relates to bank erosion is clear, and the proposed workplan should provide quantitative measures of the effects of riparian vegetation on bank erosion rates. The portion of the conceptual model related to the effects of vegetation on flood hydraulics is, however, not clear, and the work, as described, will not provide "...quantitative measures of the effects of riparian vegetation upon the hydraulics of river flood flows." As a result, I do not believe the selection of research is appropriate (or at least it neglects a key component of the hypothesis that is to be tested.)**
Rating	**fair**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	**As noted above, the approach is not well designed and appropriate for meeting the objectives of the project because it neglects an important part of the project goals (i.e., "...to develop quantitative measures of the effects of riparian vegetation upon the hydraulics of river flood flows.")** **Although I am not specifically familiar with the MBK (1978) study, the approach to evaluating the effects of vegetation on bank erosion rates appears to be feasible; however, it may have some critical limitations. As I understand the proposal, the two primary variables that will be considered in developing the bank erodibility index is bank height and vegetation classification. Bank erodibility is also strongly related to the geotechnical characteristics of the bank material (i.e, grain−size distribution, cohesive properties, stratification). These characteristics are likely to be at least as important, if not more important, than bank height and vegetation characteristics in may of the bends that are to be evaluated. Groundwater conditions and fluctuations in river stage can also be critical factors in determining bank stability and erosion rates. Since these factors will apprarently not be directly considered in the analysis, it may, in fact, not be feasible to develop valid bank erodibility indices using the proposed approach.** **The results will add to the base of knowledge regarding erosion rates since the original study at the 38 MBK (1978) sites, and the relationship between those rates and the local bank height and vegetation characteristics. The study will not add to**

	the base of knowledge regarding the effects of vegetation on the hydraulics of river flood flows. **The information regarding historic erosion rates should be useful to decision makers in assessing the potential for lateral migration at the 38 MBK sites. To the extent that the bank erodibility indices will describe the important erosion processes at the sites, results from modeling future rates and spatial extent of bank erosion due to channel migration will also be useful in assessing the relative stability and potential for channel reworking at the sites, assuming that vegetation conditions do not change in the future.**
Rating	**fair**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**The approach to evaluating bank erosion rates is reasonably well documented. Subject to the above qualifications regarding other key factors that should be included in developing the bank erodibility indices (e.g., bank material types, bank stratification, groundwater conditions), this portion of the work has a reasonable likelihood of success.** **The approach to quantifying the effects of vegetation on hydraulic roughness and flood carrying capacity is not well documented in the proposal. This issue is apparently to be addressed by the TAC, as indicated by the example questions that are listed under Task 3. Although members of the TAC may have**

	experience with these issues, development of quantitative measures that would answer the listed questions and provide "...quantitative measures of the effects of riparian vegetation upon the hydraulic of river flood flows...", would require a rigorous scientific study of a similar magnitude to the proposed bank erodibility study. As a result, feedback from the TAC on this important issue will be very general and qualitative, at best. Based on this reviewer's experience on the San Joaquin River and other similar settings, a qualitative assessment of the effects of even small changes in floodplain vegetation on hydraulic roughness is not sufficient to satisfy those concerned about flood control issues. This approach will not provide a sound basis for identifying "..Best Management Practices for managing vegetation in floodways in the Central Valley" (see Task 4). It will also not provide a sound basis for "...designing of riparian restoration planting that are flood−neutral."
Rating	**poor**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	**To the extent that comparisons between the channels in the 1978 and later aerial photographs represent monitoring, this plan is appropriately designed. The proposal does not include future monitoring to validate results.**
Rating	**not applicable**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**As described above, the products related to the relationship between historic bank erosion rates, vegetation patterns, and bank height would be of value.**
Rating	**good**

Additional Comments

Comments

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**The authors appear to have a good track record and qualifications for evaluating riparian vegetation and lateral erosion/migration along rivers. The project team does not appear to have adequate qualifications for evaluating the effects of riparian vegetation on hydraulic roughness, and the associated effects on flood carrying capacity or overbank sedimentation.**
Rating	**fair**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**Considering that the proposed work plan does not address a key goal of the project, the proposed budget**

	of approximately $830,000 does not seem reasonable.
Rating	**poor**

Overall

Provide a brief explanation of your summary rating.

Comments	**The hypothesis is timely and appropriate to meeting needs of the CALFED Ecosystem Restoration Program. The objectives of the proposed work will, however, only address one part of the issue of whether it is possible to design and manage vegetation habitat objectives in a manner that is consistent with flood control and bank erosion objectives. The proposed workplan does not adequately address the key issue of the effects of vegetation on flood hydraulics and use of that information to develop BMP's and protocols for designing riparin restoration plantings that are flood neutral. As a result, the work is unlikely to provide a sound basis for developing "...proposed guidelines for floodway vegetation management..."**
Rating	**poor**

Technical Review #3

proposal title: The Effects of Riparian Vegetation upon the hydraulics of flood flows

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**This is a vegetation and flood control proposal (Griggs) wrapped around a vegetation and meander migration proposal (Larsen). The objectives are unevenly and imperfectly stated. They are somewhat vague and too brief.**
Rating	**fair**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**Some anecdotal but reasonable justification is provided for the apparent conflict between ecological and flood control aspects of riparian vegetation. No conceptual model is provided. No existing knowledge discussed. No real justification is provided for the vegetation and meander migration parts of the proposed work, although its connection to previous work is adequate.**
Rating	**fair**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	**No approach is given for the flood control part of the proposal! Approach for the meander migration is adequate. Cannot determine the result and therefore any benefit to decision makers.**
Rating	**poor**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**Again, cannot be evaluated for the flood control part of the proposal. Feasibility for the meander migration work is adequate**
Rating	**poor**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	
Rating	**not applicable**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**Detail and explanation of flood control results weak. Meander migration results appear headed into academic journal.**
Rating	**fair**

Additional Comments

Comments

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**Based on this proposal, hard to judge qualified.**
Rating	**poor**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**Budget OK for River Partners. No budget given for Larsen.**
Rating	**poor**

Overall

Provide a brief explanation of your summary rating.

Comments	**This proposal is highly uneven and poorly coordinated. The proposal is purportedly about the effects of riparian vegetation on the hydraulics of river flood flows, motivated by the apparent conflict between the ecological benefit of riparian vegetation and its role in increasing flood levels. But, in an essentially independent section, it is also about the relation**

	between riparian vegetation and meander migration. Essentially, this is a vanishingly weak vegetation and flood control proposal (Griggs) wrapped around a vegetation and meander migration proposal with no budget (Larsen). The flood control proposal is almost entirely lacking in any detail (in any text, actually). This work (represented in Tasks 1, 3, 4, 5, 6) is barely outlined in about 2 pages and accounts for 2360 of the 2660 hours that Griggs has in the budget. Further, this work cites none of the rather extensive work on the hydraulic roughness and flood effects of vegetation. The funds requested by Griggs simply cannot be justified by the lack of explanation of the work or discussion of previous work. The Larsen proposal (Task 2) is adequately described—it is basically an extension of previous work he has done at a more detailed level of erosion and vegetation observation—but there is no budget! Larsen requests $294,000 (35% of the total request) with no budget specification at all. Again, this is unfundable.
Rating	**poor**